

Evolutionary Neural Networks Water Balance Model for Estimating Monthly Basin Discharges in Urmia Lake basin, Iran

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Abstract

In this paper a Rainfall-Runoff model using Evolutionary Neural Networks (ENN) is developed and applied in a basin in Urmia Lake located in north western Iran. Artificial Neural Networks have been used as black box water balance models for estimating basin outflow in last two decades. Most of these models are developed for areas with rainfall as the predominant form of precipitation. Therefore, for most parts around the world, including Iran, where snowfall is the main type of annual precipitation, those models have limited application and value. In this paper a neural network model is developed for a basin with snowfall as the main type of precipitation. The training process of the NN is carried out using genetic algorithm and is compared to back propagation. The model is verified using independent time series by the Nash-Sutcliffe Index as well as other evaluation criteria. Urmia Lake is currently facing a critical situation where climate change, droughts, and by a greater extent the recent developments of water consumption systems (mainly agricultural) is jeopardizing the whole existence of the Lake. Therefore, development of these models could help to better understand the behaviour of the system to the changes made and for proper assessment of different variables in the system.

Keywords: Rainfall-Runoff Model, Artificial Neural Network, Evolutionary Methods, Genetic Algorithm, Water Balance Model, Monthly Time Step, Urmia Lake Basin

Introduction:

Finding a good model to simulate streamflow by using rainfall as the input has been always one of the hydrologists' goals. During decades of challenge, rainfall-runoff models at various time scales and with varying degrees of complexity have been developed. These models are classified into the following types:

- The empirical models (or black-box models), which relate outputs to inputs through a wholly statistical or partly mathematical structure without considering the complex physical laws governing the natural process such as rainfall-runoff transformation.
- The conceptual models (or gray-box models), that consider the physical processes acting upon the inputs and outputs in a highly simplified form.